finding where images form

1) mirror EQUATION

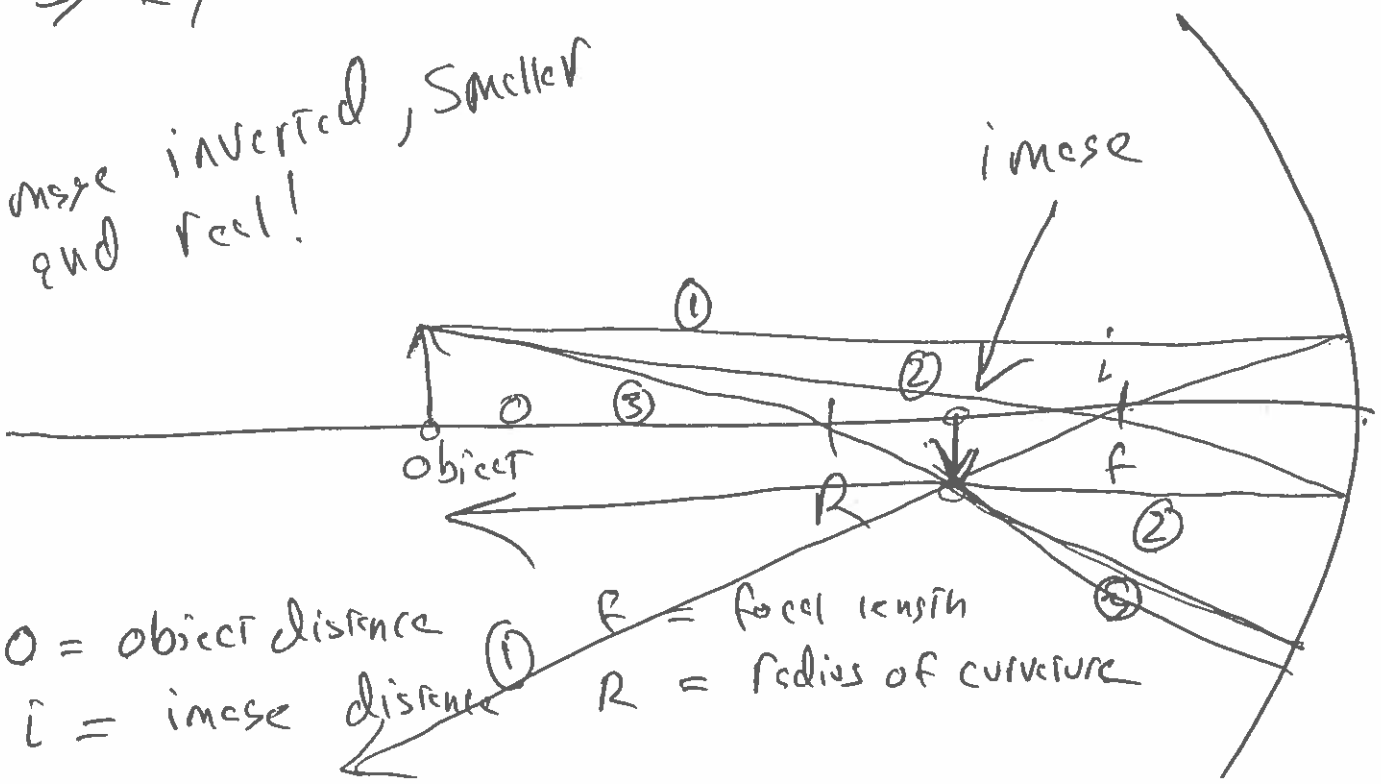
2) Ray Tracing

Ray Tracing

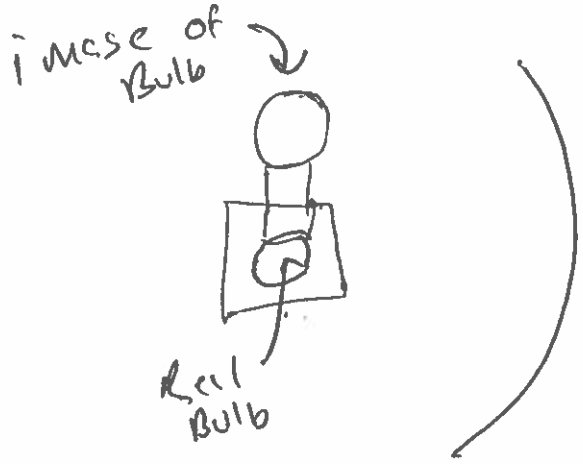
3 Rays one can draw to determine where the image forms.

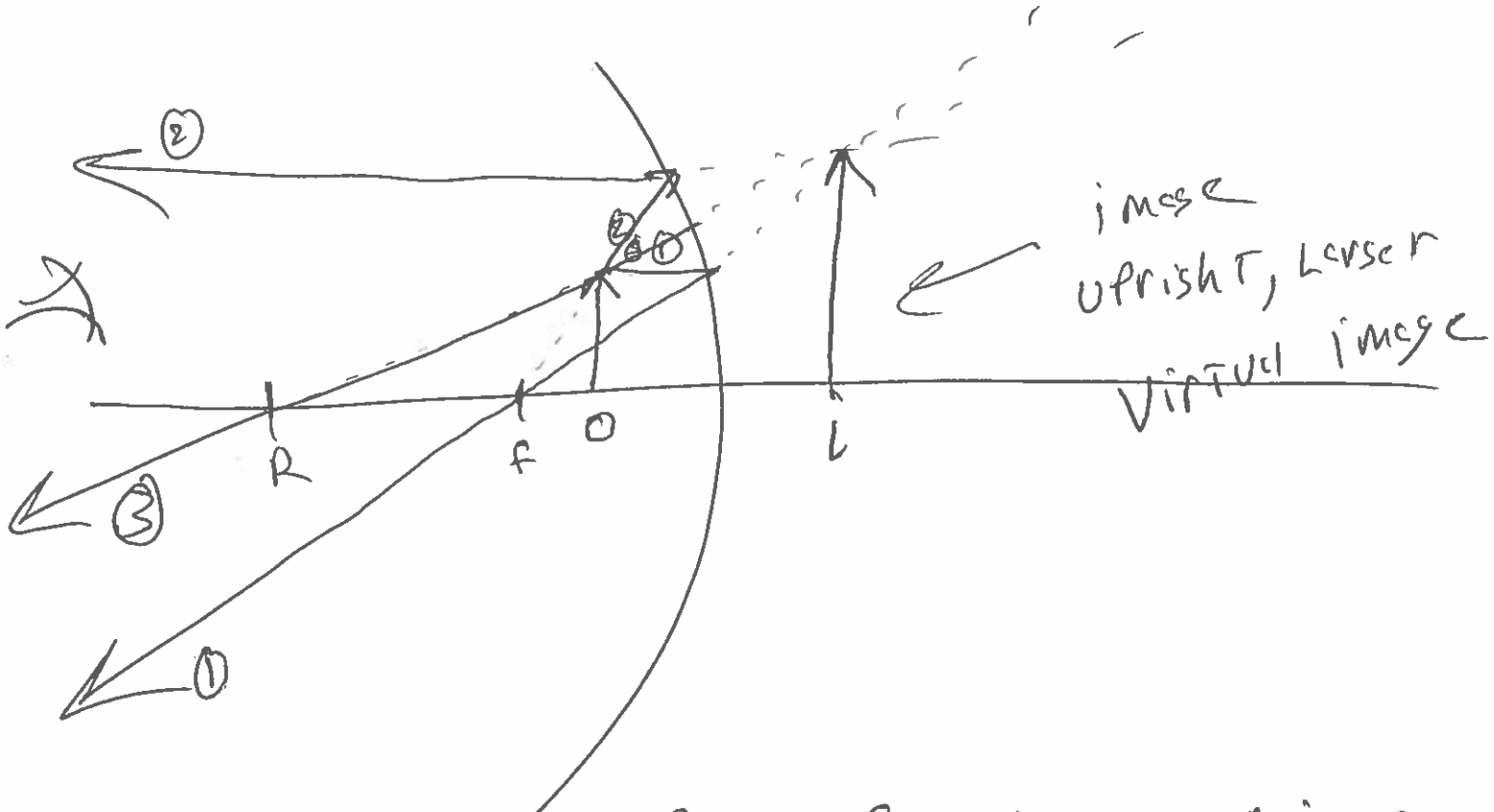
1) Parallel rays Go Through focal PT after hitting mirror
2) Ray Through focal PT Comes back Parallel to Principal axis after hitting Mirror
3) Ray Through center of curvature does not bend

image inverted, Smaller and real!



O = object distance
i = image distance
f = focal length
R = radius of curvature





when $O > f$ for concave Mirror
Real images created

when $O < f$ for concave mirror
Virtual images created

when $O = f$ image forms at ∞.

Mirror Equation

$$\frac{1}{f} = \frac{2}{R} = \frac{1}{o} + \frac{1}{i}$$

Sign Convention

real src	+	(i, o)
virtual src	−	(i, o)
concave src	+	(R, f)
convex src	−	(R, f)

eg/ object 30 cm from a 40 cm radius of curvature concave mirror, where is image? Upright or inverted, bigger or smaller?

$o = 30\,cm \quad R = 40\,cm \quad i = ?$

$$\frac{2}{R} = \frac{1}{o} + \frac{1}{i}$$

$$\frac{1}{i} = \frac{2}{R} - \frac{1}{o} = \frac{2}{40\,cm} - \frac{1}{30\,cm}$$

$$\frac{1}{i} = \frac{1}{20\,cm} - \frac{1}{30\,cm} = \frac{3-2}{60\,cm} = \frac{1}{60\,cm}$$

$$\boxed{i = +60\,cm} \Rightarrow \text{real, inverted}$$

Magnification

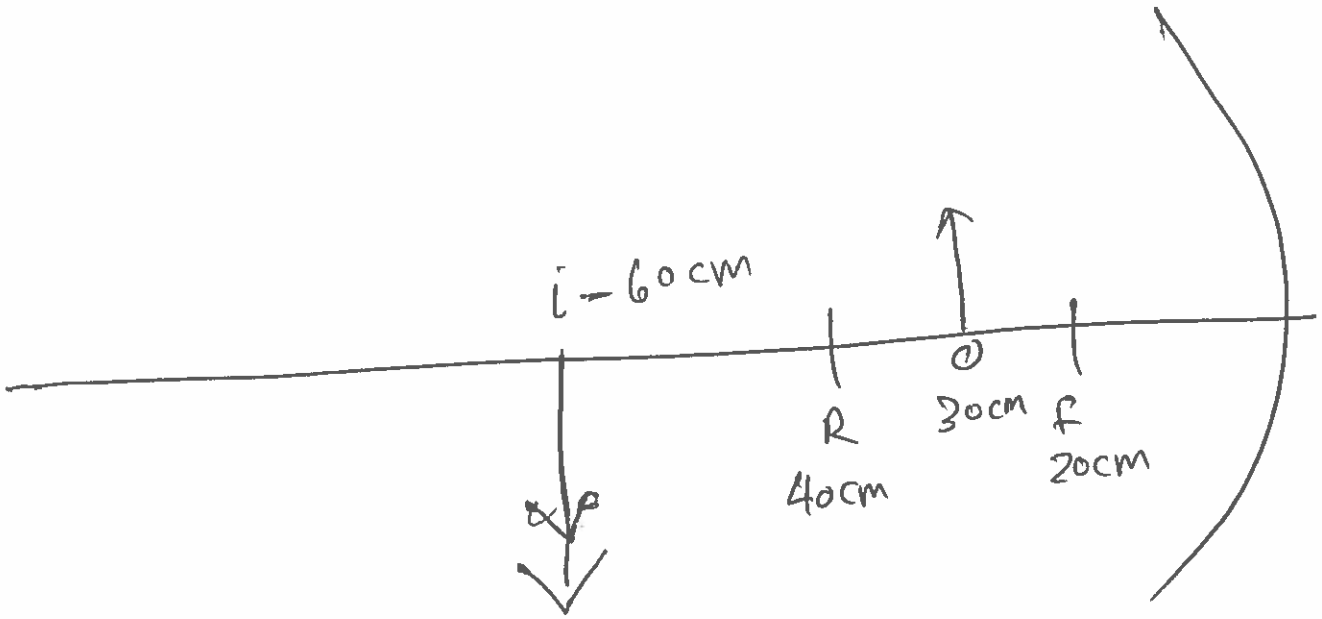
$$M = \frac{h_i}{h_o} \quad \frac{\text{image height}}{\text{object height}}$$

$$M = \frac{-i}{o} = \frac{-\text{image dist}}{\text{object dist}}$$

Here $M = -\frac{(+60\text{cm})}{30\text{cm}} = -2\times$

$-$ sign $\Rightarrow$ inverted $2\times \Rightarrow$ Bigger

Our image is located 60 cm to left of mirror, inverted, Real, Bigger



eg/ object 10 cm from a 40 cm radius of curvature concave mirror. where is image? upright or inverted? bigger or smaller?

$O = 10\,cm \quad R = 40\,cm \quad f = 20cm$

$i = ?$

$f = \frac{R}{2}$

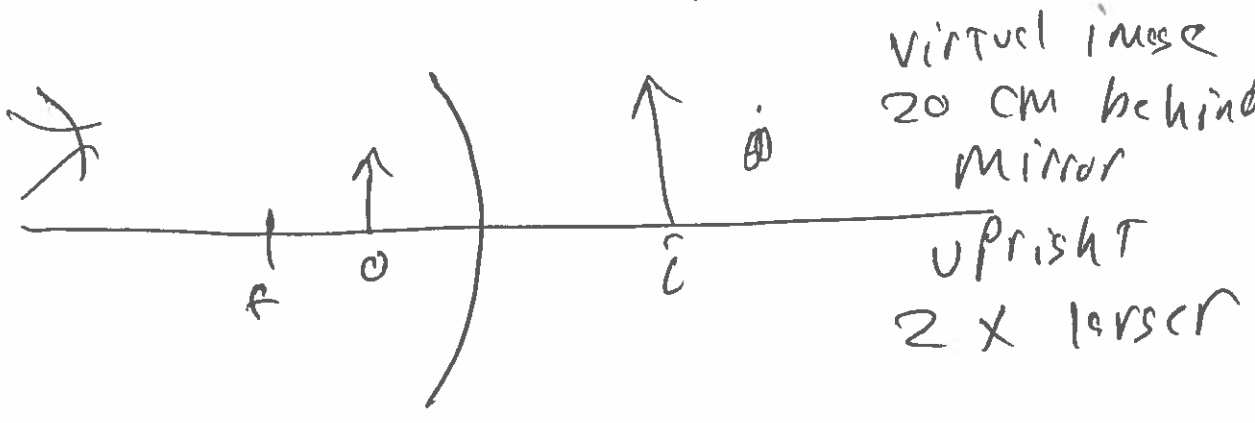
$$\frac{1}{f} = \frac{1}{O} + \frac{1}{i}$$

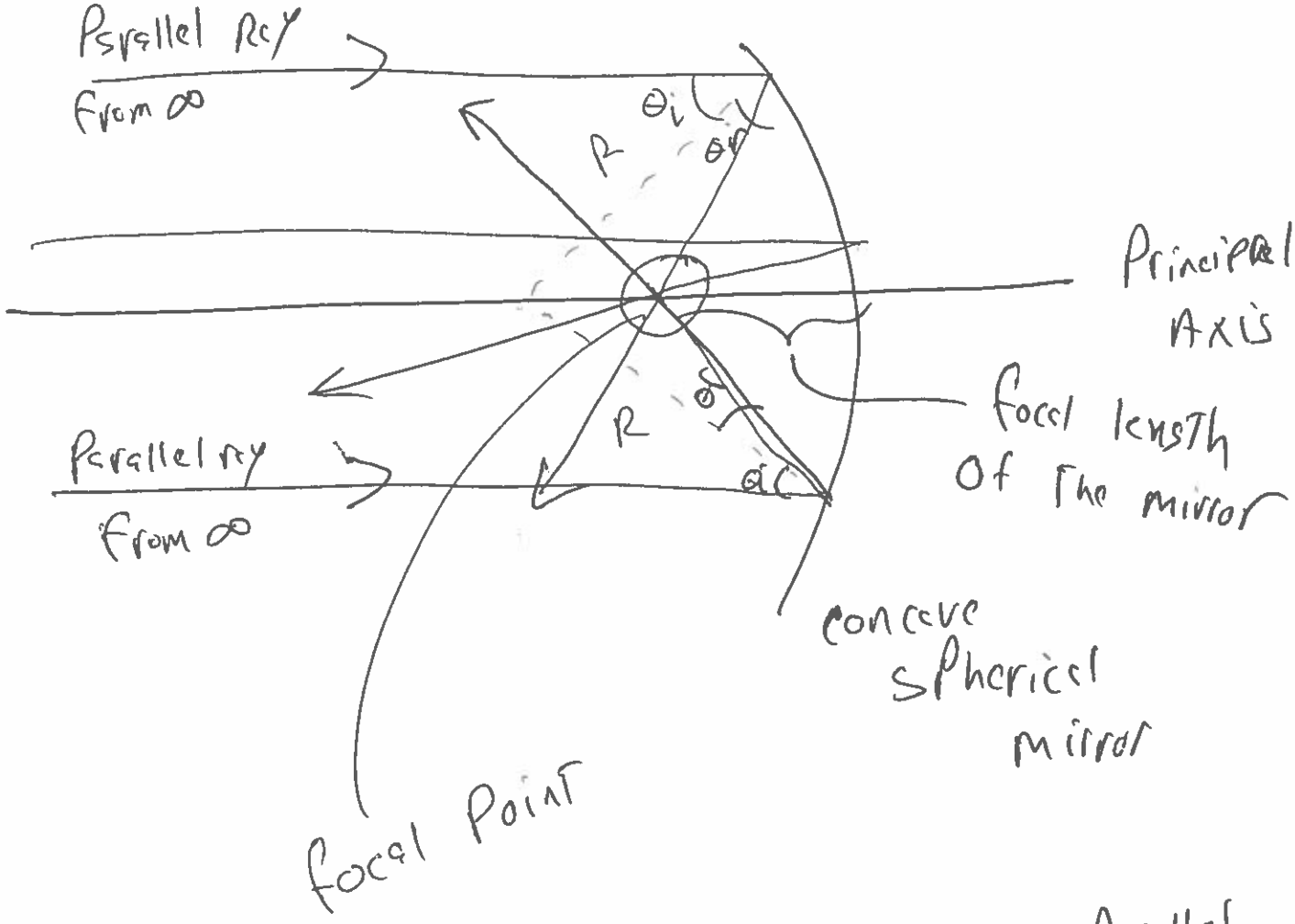
$$\frac{1}{i} = \frac{1}{f} - \frac{1}{O} = \frac{1}{20cm} - \frac{1}{10cm} = \frac{1-2}{20cm}$$

$$\frac{1}{i} = \frac{-1}{20cm} \Rightarrow i = -20cm$$

i is 20 cm behind mirror $\Rightarrow$ virtual upright

$$M = \frac{-i}{O} = \frac{-(-20cm)}{10\,cm} = +2\times$$





Focal Point is the point at which parallel rays (ie from ∞) cross after reflecting from the spherical mirror.

Focal length is the distance from the mirror to the focal point.

$f = \frac{1}{2} R$ Focal length = $\frac{1}{2}$ Radius of curvature

eg/ object 30 cm away $R = 40\,cm$

convex mirror where is i?

virtual or real?

upright or inverted?

bigger or smaller?

$$\frac{1}{i} = \frac{2}{R} - \frac{1}{O}$$

$$\frac{1}{i} = \frac{2}{-40\,cm} - \frac{1}{30\,cm} = \frac{1}{-20cm} - \frac{1}{30cm}$$

↑ Because convex

$$\frac{1}{i} = \frac{-3-2}{60\,cm} = \frac{-5}{60\,cm}$$

$$i = \frac{-60\,cm}{5} = -12\,cm$$

$$M = \frac{-(-12\,cm)}{30\,cm}$$

$$M = +\frac{2}{5}\times$$